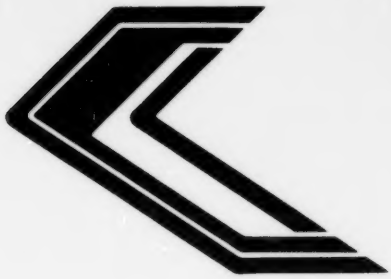

CIGAR LAKE MINING CORPORATION

CIGAR LAKE TEST MINE

ENVIRONMENTAL IMPACT STATEMENT

EXECUTIVE SUMMARY

August, 1987

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EXECUTIVE SUMMARY

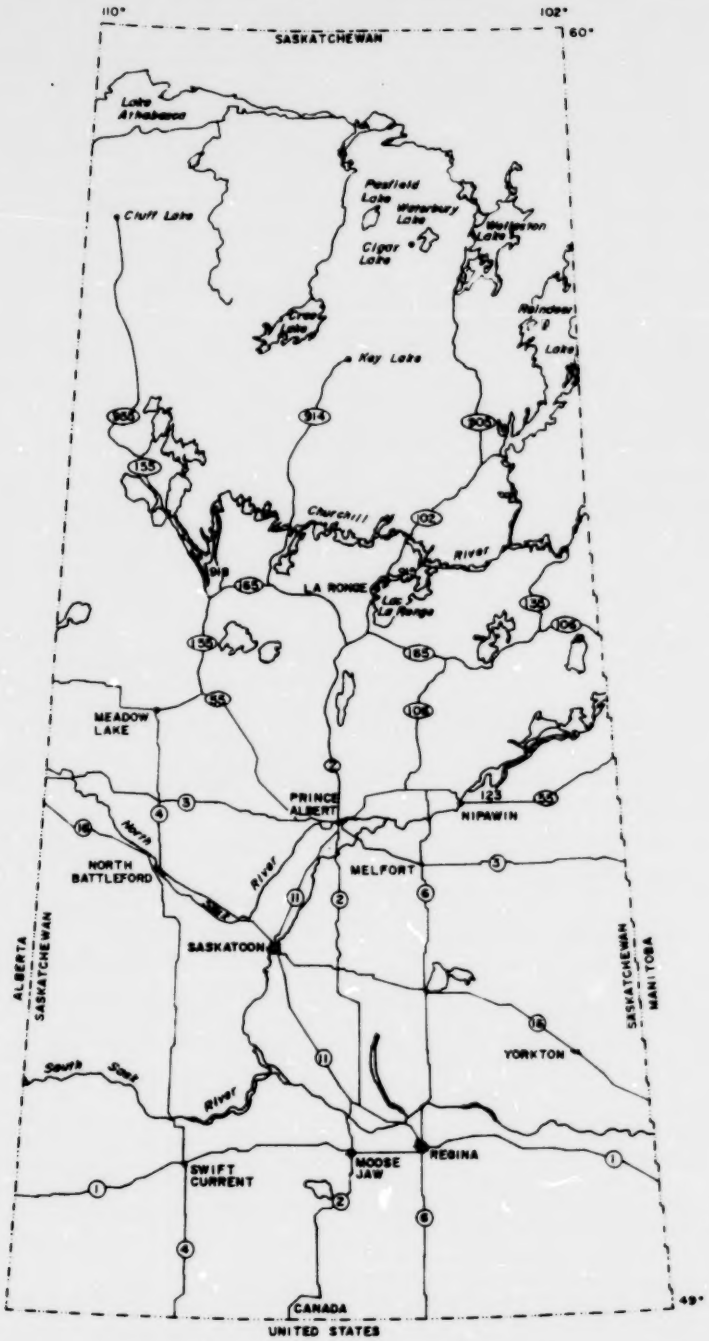
1.0 INTRODUCTION

Development of a uranium mining operation at Cigar Lake was consolidated in May 1985 when Cigar Lake Mining Corporation (CLMC) was formed in Saskatoon, Saskatchewan as a joint operating company. CLMC is owned 50.75% by Saskatchewan Mining Development Corporation, 32.62% by Cogema Canada Limited, 12.87% by Idemitsu Uranium Exploration Canada Ltd. and 3.75% by Corona Grande Exploration Corporation (a wholly owned subsidiary of Cogema).

The Cigar Lake uranium deposit is located at the south end of Waterbury Lake in northern Saskatchewan (Figure 1.1). It is the largest high grade uranium deposit in the world. The total ore reserves are estimated at 150,000 tonnes of uranium (385 million lbs. of U_3O_8) contained in ore averaging about 8% uranium. The orebody lies at a depth of 430 metres below surface and occurs as a flat crescent shaped deposit 2 kilometers in length, 25 to 125m wide, and has a thickness ranging from 1 to 20m.

Original exploration work beginning in 1976 was carried out by airborne geophysical survey and sediment/water geochemistry. A diamond drilling program began in 1981 and mineralization was discovered that year. Between 1981 and 1986 approximately 150 more drill holes intersected the deposit and confirmed the extent of the reserves.

At the same time as the ore reserves were being confirmed a number of other studies; such as environmental baseline, radiological assessments, geotechnical and hydrogeological modelling and review of possible underground mining methods, were being carried out in order to assess the technical, economic and environmental



CIGAR LAKE MINING CORPORATION

TITLE		
PROJECT LOCATION		
DATE JUNE '86	DRWG No	FIG No 1.1

feasibility of mining the deposit. The studies provided invaluable information for assessment purposes, however, there are still many uncertainties that have to be resolved before the technical feasibility of mining this deposit can be established. Additional information has to be gathered on ground conditions and support requirements, groundwater flow and quality, and how the proposed mining methods can be adapted to actual conditions. This level of information can only be obtained by underground mine development. For these reasons the Cigar Lake Mining Corporation is proposing a Test Mine Project as the logical next step in its development plans.

2.0 PROJECT PROPOSAL

Cigar Lake Mining Corporation (CLMC) proposes to undertake a Test Mine Project as a partial step toward its overall plan to develop and operate a uranium mining complex at Cigar Lake. Major components of the Test Mine Project are:

a) Sinking a vertical mine shaft to approximately 480 metres depth.

b) Lateral development of two horizontal drifts to provide access to the orebody.

c) Test mining (stoping tests) of three alternative mining methods within the orebody.

d) development of surface facilities and ancilliary equipment to support year-round operation of the test mine.

The project is scheduled for the next 2 1/2 years (mid 1987 to late 1989) (Figure 2.1) and will employ contractor personnel and CLMC support staff located at site as well as administrative, engineering and environmental support staff in Saskatoon.

DESCRIPTION	MONTHS
SURFACE CONSTRUCTION	
SITE PREP. - CAMP INSTALLATION	
SURFACE CONSTRUCTION	
TEST MINE - VERTICAL DEVELOPMENT	
GROUND FREEZING	
COLLAR CONSTRUCTION	
SHAFT CONSTRUCTION	
LATERAL DEVELOPMENT	
STATION CONSTRUCTION	
ACCESS TO STOPING TEST AREA	
VENTILATION RAISE	
GROUND FREEZING	
COLLAR CONSTRUCTION	
RAISE CONSTRUCTION	
STOPING TEST	

1986 1987 1988 1989 1990 1991

JU AU SE OC NO DE JA FE MA AP MA JU JU AU SE OC NO DE JA FE MA AP MA JU JU AU SE OC NO DE JA FE MA AP MA JU JU AU SE OC NO DE JA FE MA AP MA JU JU AU SE OC NO DE JA FE MA AP MA JU

REVISED AUG '87
REVISED MAR '87

REVISION

CIGAR LAKE MINING CORPORATION

TITLE

TEST MINE DEVELOPMENT SCHEDULE

DATE	DRWG. No.	FIG. No
JUNE '86		2.1

3.0 NEED FOR PROJECT

Technical studies for the development of a feasible mining approach to the Cigar Lake ore body have reached a point where additional exploration from surface will not provide the detailed information needed to aid in the selection of a suitable mining method, and yet there are still many uncertainties which have to be resolved before an appropriate selection can be made.

The question of ground stability has to be one of the most important factors affecting the evaluation of a technically feasible mining method.

High levels of in-situ stress existing in the massive clay zone above the ore body are a major concern, however the distribution of the massive clay, the intensity and attitude of the associated structures, and the heterogeneous nature of the compositon of the clay zone itself all influence the levels of in-situ stress. This information is very important for mine planning purposes. In addition, the impact of the altered sandstone (above the clay zone) on the overall ground support requirements, is not well understood due to the high levels of core loss occuring in the drilling in this area.

Extensive groundwater studies have provided most of the information needed to design a minewater inflow control system. The impact of minewater inflow on ground stability can only be determined by in-situ testing. The groundwater, because of its capacity to carry radon gas, is a major consideration in the design of the mine ventilation system.

During the underground development stage there are potential workplace radiological, and environmental hazards, which must be identified and evaluated in order to properly control and minimize the level of worker exposure.

Because of the level of detailed information required and the necessity to confirm the structural interpretation before proceeding further with the mine design, Cigar Lake Mining Corporation plans underground development in the form of a test mine to gather the required information on which to evaluate the technical feasibility of the proposed mining methods.

4.0 PROJECT DESCRIPTION

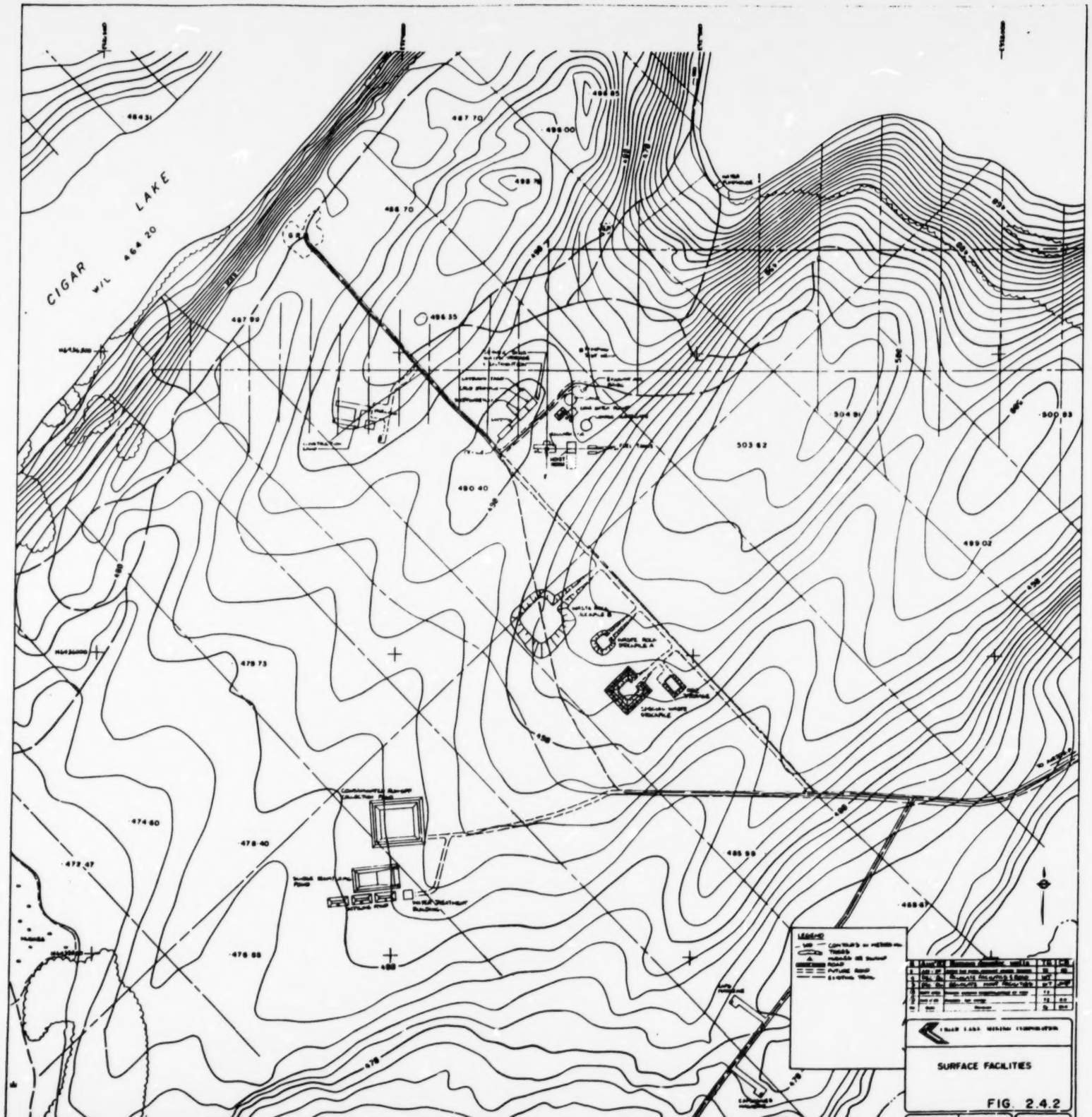
The objective is to prove the technical feasibility of mining this ore deposit. The orebody and the underground environment in which it occurs presents some exceptional challenges that must be dealt with and this can only be done by carrying out an actual mining test.

Generally, the Test Mine Program involves:

- sinking of a vertical shaft some 480m deep;
- excavation of horizontal drifts and construction of underground facilities to develop the test mine area;
- mining of approximately 5000 tonnes of ore during the test mining phase;
- construction of the surface facilities required to carry out the Test Mine Program.

Surface development features are shown in Drawing #CL-S-003. Items relating directly to underground development are;

- headframe and collar house;
- power and compressed air plant;
- hoist house;
- fuel storage;


CIGAR LAKE
W/L 464.20
SURFACE FACILITIES
FIG. 2.4.2

- fresh air fan and heater house;
- *concrete batch plant;*
- offices, dry, workshop.

Other auxilliary surface facilities which are required to support underground development are:

- water pumphouse;
- aggregate preparation plant;
- waste rock and ore stockpiles;
- construction camp;
- sewage treatment facilities;
- explosive magazines;
- roads, powerlines, fuel storage;
- minewater treatment plant.

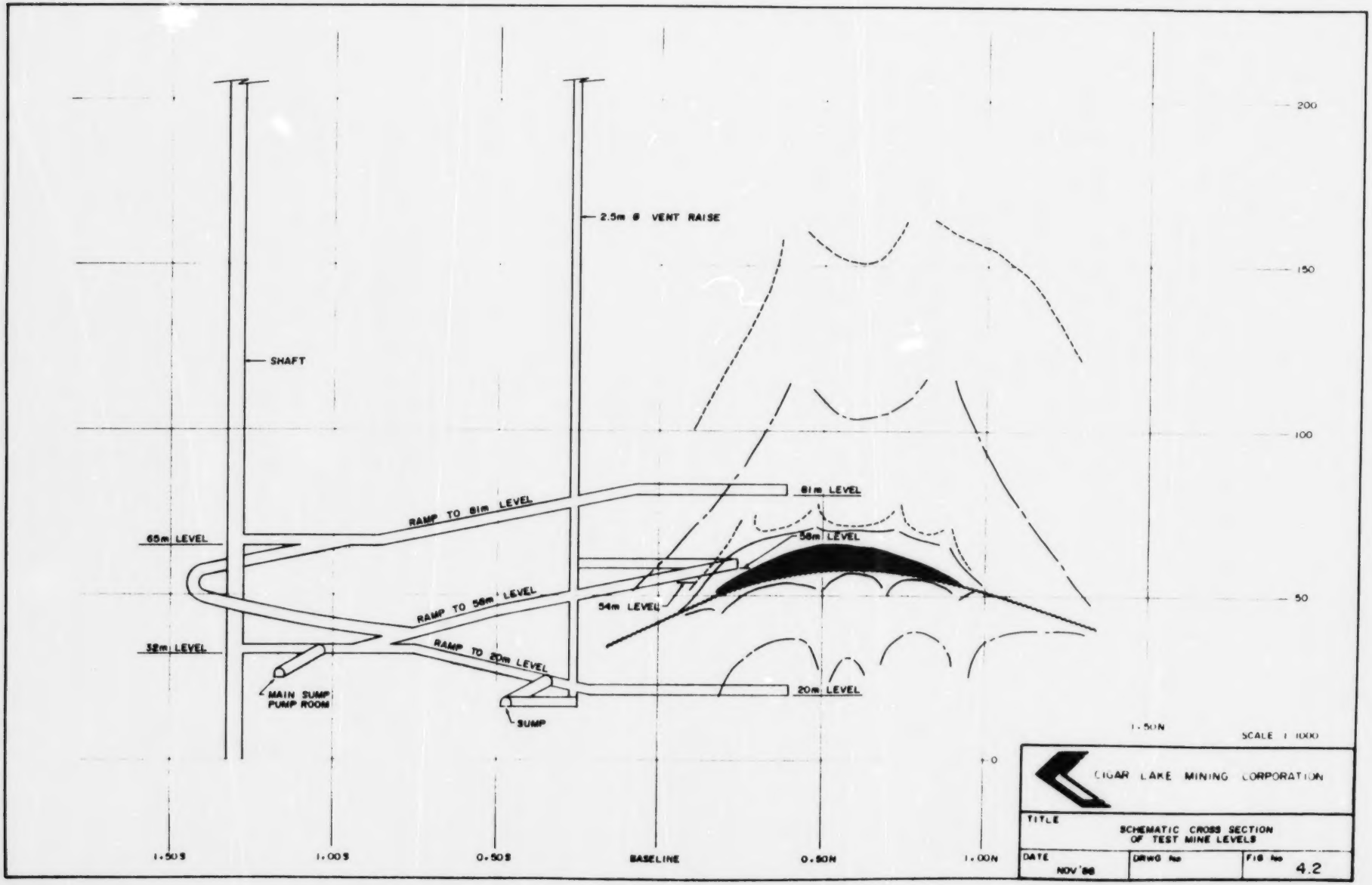
Underground development consists of both vertical and lateral excavation as shown schematically in Figure 4.2. (NOTE: Underground development is located relative to sea level which is about 480 m below surface at Cigar Lake.)

Access to the mine will be provided by a vertical 480m deep shaft approximately 150m south of the orebody. A concrete lined collar will be constructed through the overburden and anchored into bedrock.

A ventilation duct will be instlled in the shaft and used to provide fresh air to the mine workings during the test mine operation.

Shaft stations will be excavated at the 32m and 65m levels (See figure 4.2). These stations will be used to provide access to the mine for movement of personnel, equipment and supplies.

Shaft conveyances will consist of a cage operating in balance with a cage/skip combination.


200
150
100
50
0
2.5m ø VENT RAISE
SHAFT
81m LEVEL
RAMP TO 81m LEVEL
65m LEVEL
58m LEVEL
RAMP TO 58m LEVEL
54m LEVEL
52m LEVEL
RAMP TO 20m LEVEL
MAIN SUMP PUMP ROOM
20m LEVEL
SUMP
1.50S
1.00S
0.50S
BASELINE
0.50N
1.00N
1.50N
SCALE 1:1000
CIGAR LAKE MINING CORPORATION
TITLE
SCHEMATIC CROSS SECTION OF TEST MINE LEVELS
DATE
NOV '88
DRWG No
FIG No
4.2

Lateral access to the orebody will be provided by development on three levels. These levels are at approximately 20m, 58m, and 81m. The main orebody lies between the approximate 50m and 65m level (see Figure 4.2)

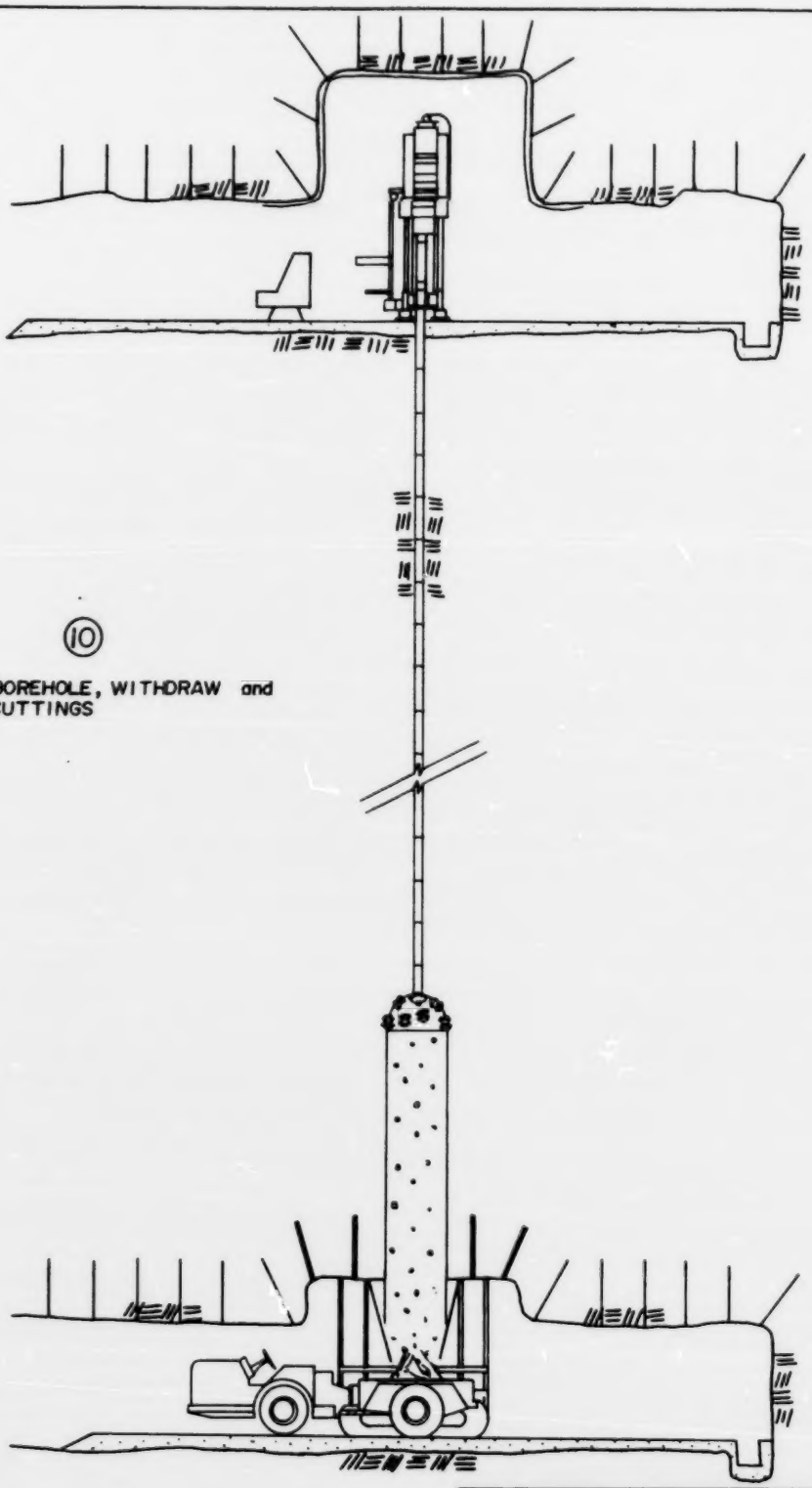
Underground service facilities will be comprised of: a) pumproom with clean and contaminated water sumps; b) repair garage and refuge station; c) electrical substations.

A 2.4m diameter ventilation exhaust raise would be constructed close to the orebody to meet ventilation requirements.

Stoping tests will be carried out on three selected mining methods: 1) raise boring; 2) blind drilling; 3) undercut and fill. Schematic cross sections are shown in Figures 4.3 to 4.5. The stoping tests will be carried out on an experimental basis to gather design information on ground stability, radiation, exposure to high grade uranium ore, mining equipment operation, and ore handling procedures.

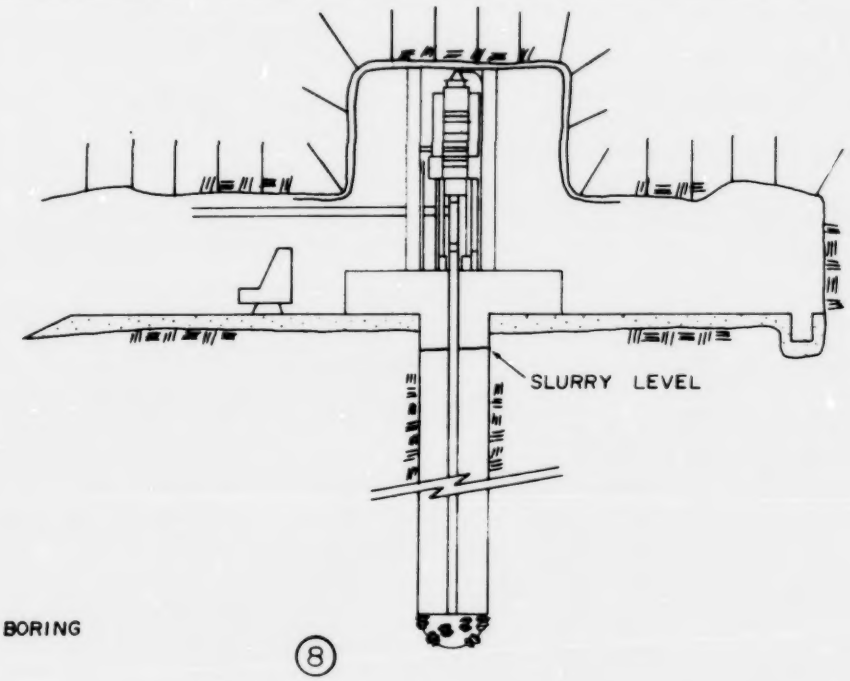
Prior to any extensive subsurface development, a plan to control water inflow will be instituted. The plan is to control the flow of water into the mine workings by sealing off the fractures with grout and reducing the inflow to a manageable level. The water inflow would then be collected in sumps and pumped to surface for treatment and discharge.

A temporary road constructed from Highway #905, N.E. of Waterbury Lake, along the east side of the lake and entering the Cigar Lake property from the S.E will provide access. The road is being built to accommodate all-terrain vehicles and will supplement the existing winter road.



CIGAR LAKE MINING CORPORATION

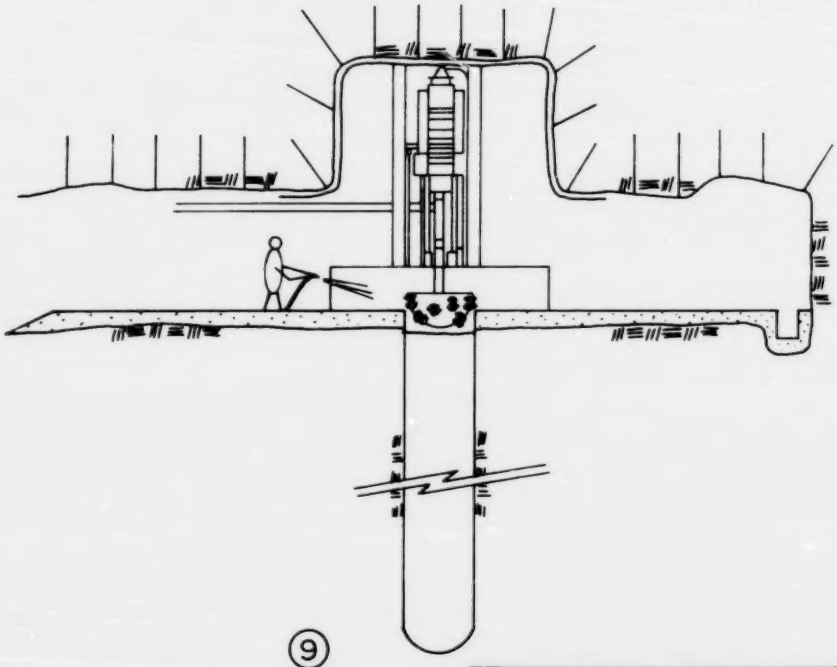
TITLE		
RAISE BORING		
DATE: NOV '86	DRWG. No:	FIG. No: 4.3



81m LEVEL

BLIND BORING

⑧



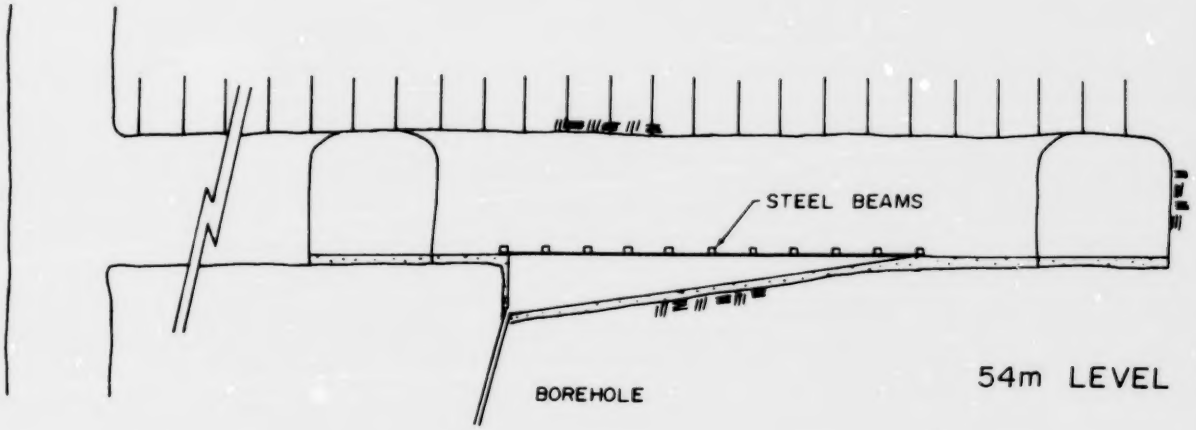
81m LEVEL

⑨

REMOVE BLIND BORER HEAD AND WASH

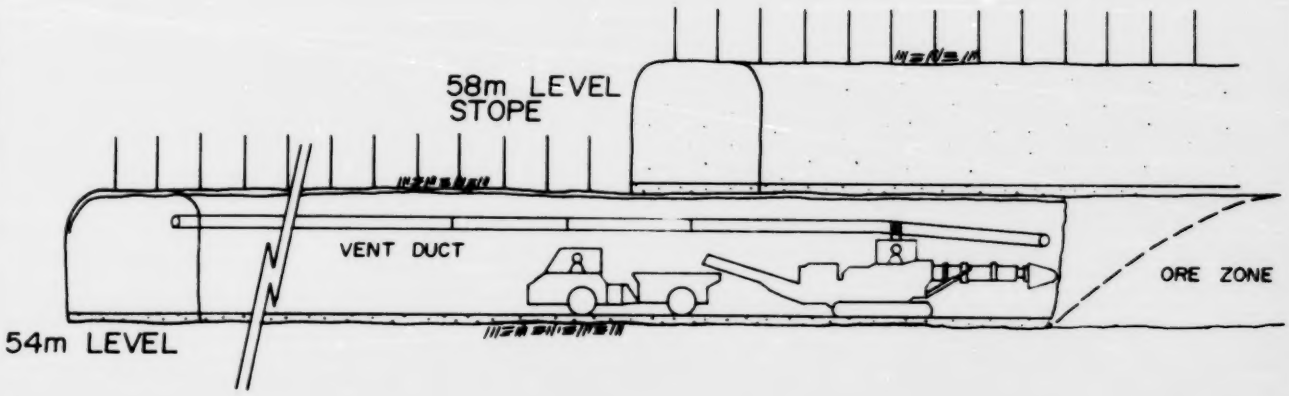
CIGAR LAKE MINING CORPORATION

TITLE		
BLIND BORING		
DATE NOV '86	DRWG. No.	FIG. No. 4.4



(14)

SET UP WASH BAY



(15)

EXCAVATE STOPE FROM ACCESS DRIFT TO ORE CONTACT

CIGAR LAKE MINING CORPORATION

TITLE		
UNDERCUT AND FILL		
DATE	DRWG. No	FIG. No.
NOV '86		4.5

5.0 WORKER HEALTH AND SAFETY

Close attention to both conventional safety and radiation safety will be given during the Test Mine Project.

Surface construction, shaft sinking and lateral development are mostly related to conventional occupational hazards whereas test mining, particularly within the orebody, has the additional health risk of radiation exposure. Both external and internal radiation exposure will be given attention.

6.0 ENVIRONMENTAL BASELINE

Environmental impact can be described as the changes induced by the project activities on the surrounding environment. In order to assess the magnitude of these changes it is necessary to know what the conditions were prior to project activity. These conditions are known as environmental baseline (or background).

Environmental baseline data has been gathered since 1983. The data includes information on climate, air quality, soils and vegetation, wildlife, heritage resources, groundwater and surface water quality, aquatic ecology, surface hydrology, radiology and socio-economic considerations.

Air Environment

Climate and meteorological data have been gathered from regional weather stations to provide an overview of information required for predictive assessment. Site specific weather information is being gathered by means of a weather station at the exploration camp site.

Suspended particle levels are in the range of 11 - 35 ug/m^3 (microgram per cubic metre) for background conditions. This is considered a typical dust loading for non-urban areas and conforms to measurements taken at Dawn Lake and Rabbit Lake.

Sulphur and nitrogen compound levels are very low. Sulphur dioxide concentrations range from 7.5 to 22 ug/m^3 for the region and are below the working range of standard reference methods for comparison of SO_2 concentrations.

Terrestrial Environment

The surface topography is dominated by drumlins and eskers. From surface to bedrock there are unconsolidated deposits of glacial drift including till, sand, and gravel. Bedrock is a sandstone of the Athabasca group. Muskeg is common throughout the area, bogs and marshes are characteristic features. There are frequent zones of permafrost in poorly drained areas.

Vegetation in the general area consists of Jack Pine forests with muskeg areas consisting of Black Spruce and Tamarack. There have been no rare or endangered species identified. Forest fires have played a major role in the pattern of growth.

Wildlife habitat values for the area have been assessed as very low, burned over areas are not conducive to large populations of ungulates or furbearers. There is a low diversity of small mammals and bird species. Migrating caribou herds do not normally travel to the southern end of Waterbury Lake.

Heritage resource sites that were originally identified as being of potential interest in a preliminary survey were later studied in detail and found to be of little significance.

Aquatic Environment

Water quality is generally described in terms of PH, conductivity, total dissolved solids, alkalinity, trace metals, radionuclides and major constituents such as chloride, sulphate, carbonates, calcium magnesium, sodium and potassium. Water quality can be catagorized by source:

a) Groundwater

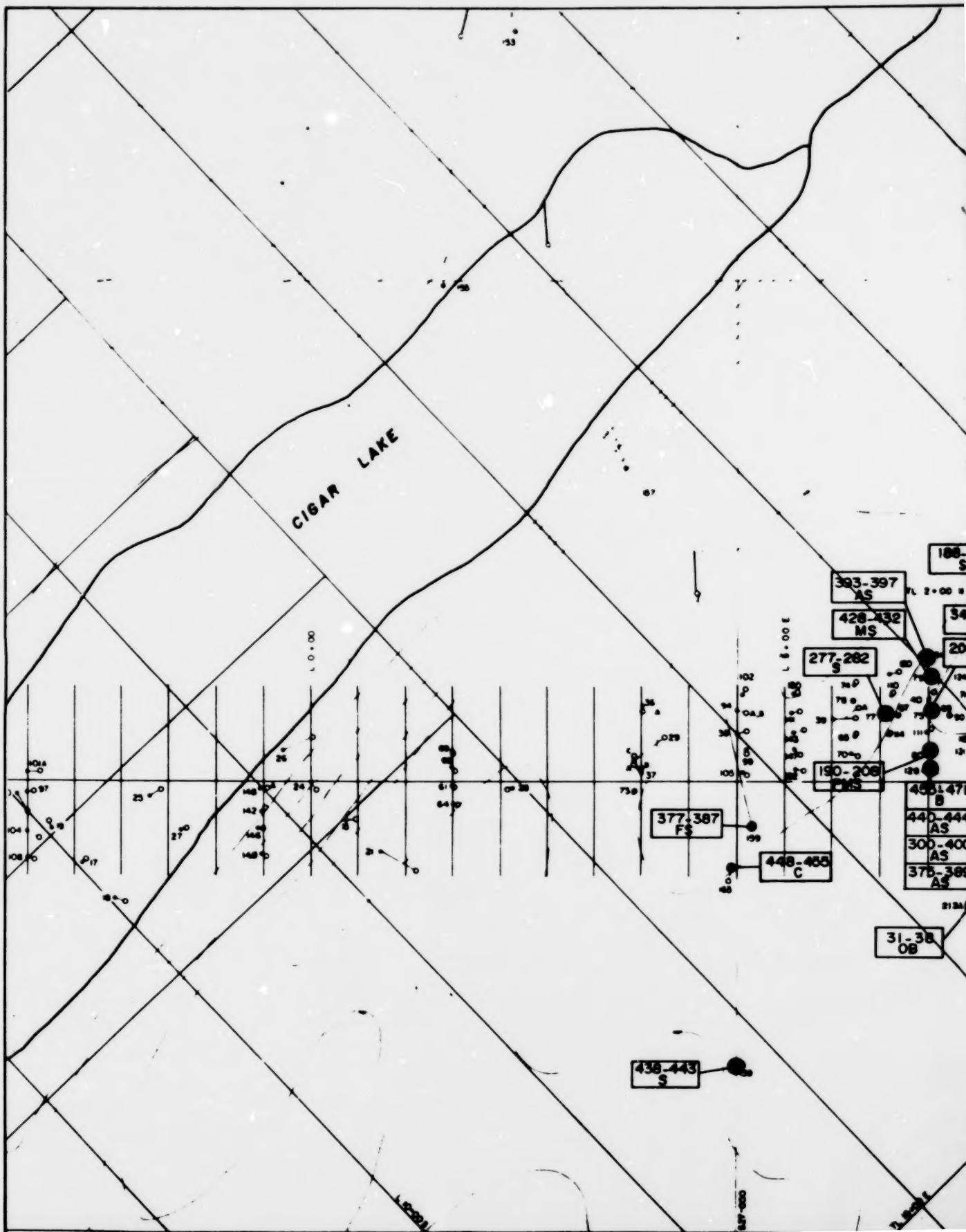
Groundwater sampling has been carried out in a number of piezometers in the vicinity of the orebody and project area (Figure 6.1) as well as during the single well, eight day pumping test which provided information on water volume and quality under dynamic conditions.

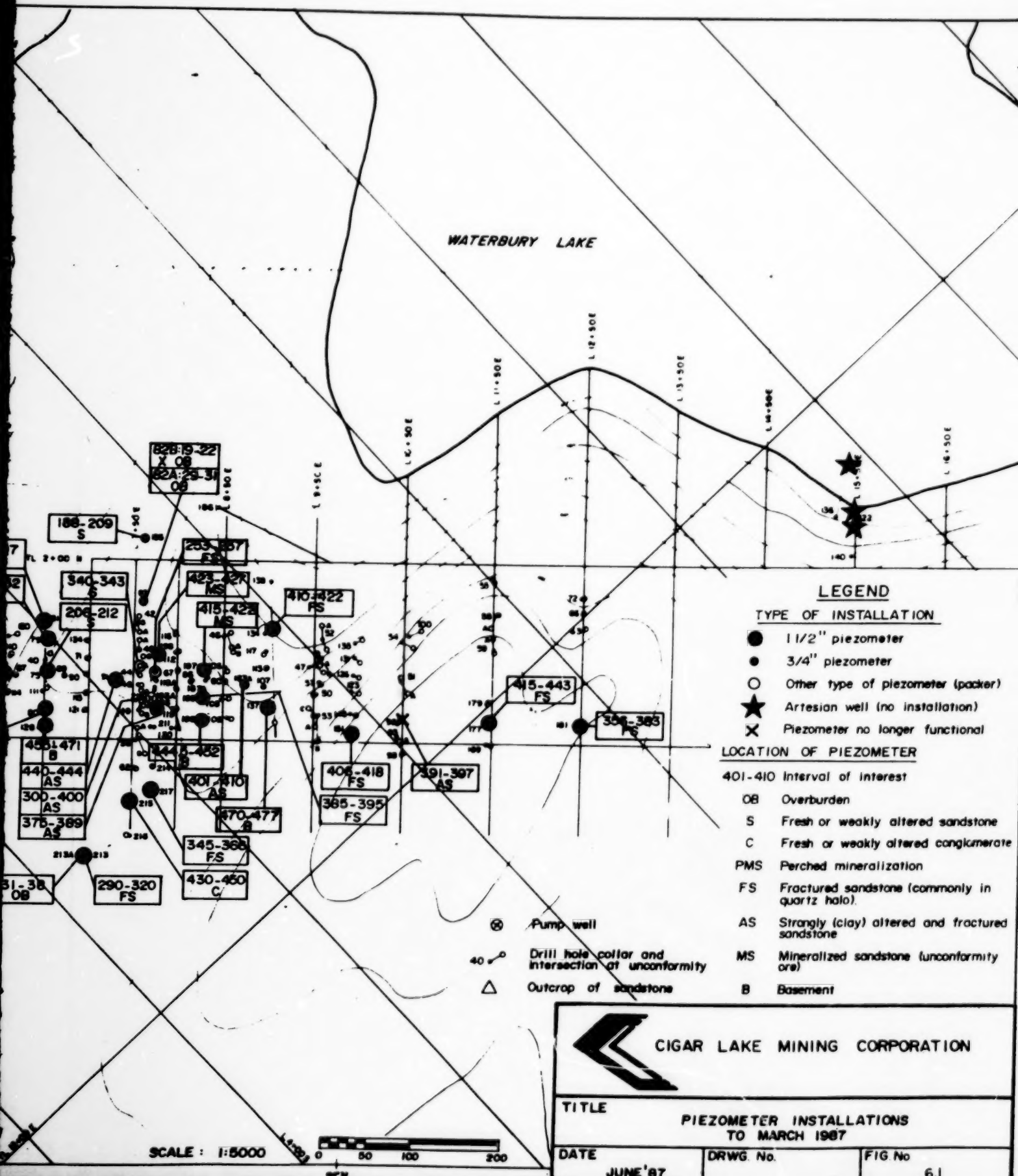
The pH of the majority of the samples of the groundwater collected to date ranges from 6.5 to 8.3 which is close to the range for surface waters and suitable for any industrial or domestic use as well as direct discharge to the evironment.

Conductivity of the waters would generally be considered low for groundwaters. The conductivity and total dissolved solid levels in any water likely to be pumped from around the orebody will not in themselves result in any significant water quality concerns.

Such major constituents as bicarbonates, chloride, sulphate, sodium, calcium, potassium and magnesium show a wide range of concentrations, but with the possible exception of some constraints relating to iron, the groundwaters around the Cigar Lake orebody could, with respect to major water quality parameters be considered for direct discharge.

Of all the trace elements, only the values for manganese were found above the 50 mg/L (milligrams per litre) criteria set for drinking water, and here there appears to be a large temporal


CIGAR LAKE
393-397
AS
428-432
MS
277-282
S
190-208
MS
377-387
FS
448-468
C
438-443
S
31-38
08



CIGAR LAKE MINING CORPORATION

TITLE		
PIEZOMETER INSTALLATIONS TO MARCH 1987		
DATE	DRWG. No.	FIG No
JUNE '87		6.1

variation. From a water quality standpoint the level of manganese is not anticipated to be a problem as the level of 50 mg/L is based upon aesthetic considerations (taste, precipitate) which is not anticipated to be an issue in dewatering operations.

In general, the levels of cadmium, copper, lead and zinc are found in the groundwaters around the orebody at levels of about ten times that found in surface waters in the area. Some effect may be anticipated in the immediate discharge area, although if discharged to the muskegs surrounding Aline Lake, it is probable that natural complexing of these trace elements with organic material here and in Aline Lake and in the creek below will reduce absolute concentrations and bio-availability of the remaining trace elements to the point where chronic toxicity would not be an issue.

The levels of uranium in groundwater collected prior to the pumping test were, with a couple of exceptions, less than the drinking water limit of 20 ug/L and based upon data obtained from analysis of the pumping test discharged water (0-4 ug/L) is likely to be at acceptable levels for discharge directly to the environment during the test mine development.

Levels of Ra-226 away from the mineralization appear to be below the 0.1 Bq/L (Becquerel per litre) required by the Saskatchewan Surface Water Quality Objectives before direct (untreated) discharge is allowed to surface water bodies. Levels in the mineralized areas ranged between 0.2 and 2 Bq/L.

The Ra-226 concentration in the water flowing into the test stopes will depend upon the relative quantities of water drawn from mineralized areas. An assumed worst case scenario provides for the chemical treatment of all minewater flow.

The levels of Lead-210, Thorium-230, Thorium-232 and Thorium-228 in both mineralized and non-mineralized zones would appear to be below the ecologically significant effect level.

b) Surface Water Quality

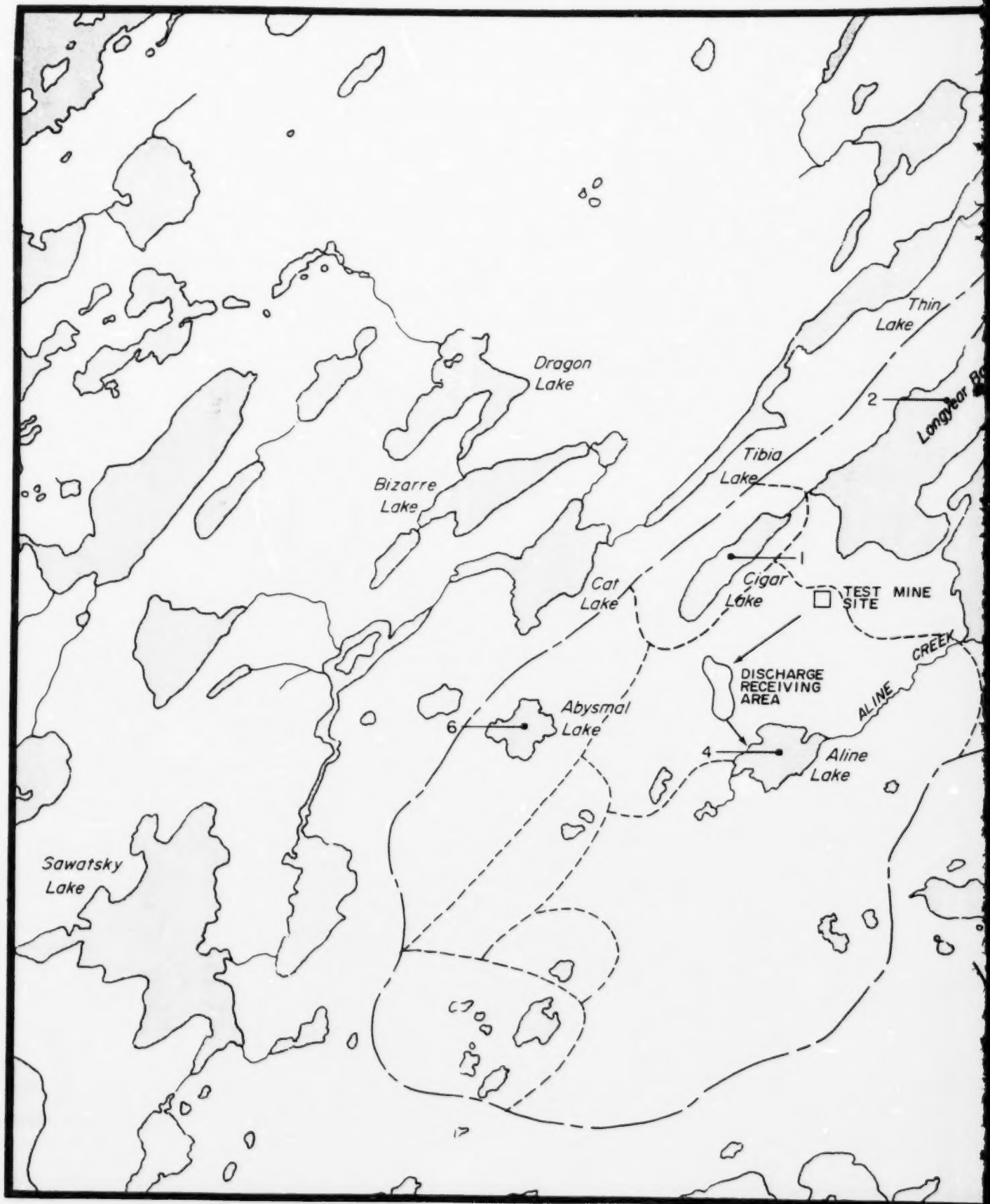
Careful monitoring of the quality of a number of surface water bodies in the project area has been undertaken for several years resulting in a good background for operational monitoring. Those of significance to the test mine proposal include Longyear and Seru Bays on Waterbury Lake, and Aline Lake (Figure 6.2).

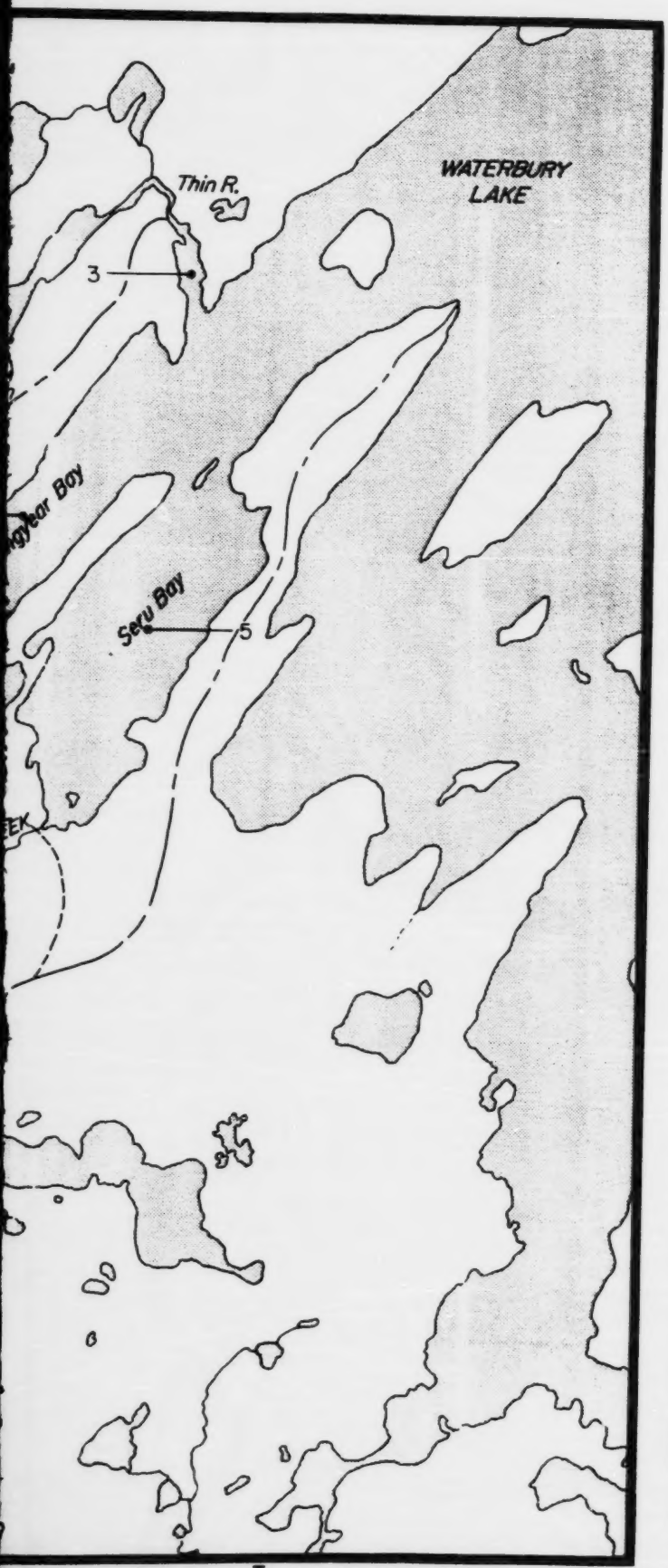
Surface water quality can be described as follows.

In general, the area waters could be described as very clean with good clarity, colour and low suspended solid material.

All of the physical parameters analyzed for were within the range predicted for the site based upon regional data. All parameters are within the ambient objectives for surface waters in Saskatchewan. Nothing anomalous in terms of gross water quality parameters was noticed during yearly surveys.

Major constituents are those water quality parameters responsible for describing the majority of chemical species in solution. Because well-leached sandstones and relatively insoluble erratic boulders in the region contribute very little to the dissolved solids in the local surface waters, most of the major anions and cations in solution are found at concentrations comparable to those found in rainfall at Cree Lake, the closest atmospheric monitoring station for which analytical data are available. All of the water quality parameters measured were within the background range suggested by data collected in other parts of the region. The waters would be classified as very soft, with total alkalinity values near 5 mg/L ($CaCo_3$). These waters have a very


Thin Lake
Dragon Lake
2
Tibia Lake
Bizarre Lake
1
Cat Lake
Cigar Lake
TEST MINE SITE
DISCHARGE RECEIVING AREA
ALINE CREEK
Abysmal Lake
6
4
Aline Lake
Sawatsky Lake



LEGEND

5 Monitoring Location

Watershed Boundary

Sub-Basin

CIGAR LAKE MINING CORPORATION

TITLE
SURFACE WATER MONITORING LOCATIONS

DATE	DRWG. No.	FIG. No.
MAR '87		6.2

0 0.5 1.0 2.0 3.0 Km

N

poor buffering capacity. The major cation present is silica with values that appear to fluctuate seasonally from less than 1 to almost 6 mg/L. The seasonal fluctuations in both silica and alkalinity are suspected of being due to seasonal uptake by algal communities.

General nutrient compounds made up of carbon, nitrogen and phosphorus were analyzed as part of a baseline study to document nutrient controls on aquatic productivity. Nutrient levels measured were all within the predicted range and well within ambient surface water quality objectives for the province of Saskatchewan. Phosphorus, based upon data collected to date, appears to be the limiting nutrient. Lakes with these low nutrient levels provide little support for plant growth.

The trace constituents may be classed as toxic elements if their environmental concentrations rise high enough. At the same time, many of them are essential elements necessary for the growth and survival of aquatic organisms. Levels of fluoride were well within the maximum level predicted for the area. Measured concentrations of all of the other trace elements are at levels that would be considered as background for this area. There does not appear to be any noticeable influence of the orebody mineralization on the surface water quality in the immediate area.

c) Surface and Groundwater Hydrology

Surface hydrology data for the project site and surrounding area is a combination of regional information and locally measured stream flows and lake level data.

The Waterbury Lake drainage basin, of which the Longyear - Seru Bay watershed is part, is comprised of numerous depressions occupied by bogs or shallow headwater lakes. Irregular streams connect the waterbodies in a generally northerly direction of flow.

The project is located within the major watershed boundaries for Longyear Bay and Seru Bay (Figure 6.2). Within the watershed there are a number of sub-basins. The Aline Lake drainage area is the major sub-basin within the watershed. Surface facilities have been located within the Aline Lake sub-basin. Runoff and discharge from the Test Mine site will flow into a marsh wetland area south of the site and then into Aline Lake. Aline Lake receives flow from other areas of marsh and bogs. The lake discharges through Aline Creek into Seru Bay.

Measured unit area runoff for the local watersheds has been determined to be $0.0120 m^3/s/km^2$ (cubic metres per second per square kilometre) which is higher than the regional findings of $0.0066 m^3/s/km^2$ and is attributed to the additional groundwater discharge flows.

Flushing rates have been calculated for Aline Lake and range between 3 days (flood) and 42 days (drought) with an average rate of about 24 days. Aline Creek has an average flow of 420 m^3/h. Flow through the creek is continuous year round.

Groundwater hydrology described here is referring to the groundwater regime in the surficial deposits located between bedrock and surface (commonly known as overburden or drift).

A fairly static regional groundwater table is controlled by the recharge from the numerous local lakes. The level has been measured at approximately 467m and generally follows the contours of the surface features. Some local perched water tables have been encountered above frozen soils or where loose granular layers overlay dense sandy till.

Some evidence of localized upward hydraulic grandients have been indicated by artesian conditions along the shores of Cigar Lake and Waterbury Lake.

Hydraulic conductivities in the overburden have been tested and found to be in the order of 10^{-5} cm/sec which is consistent with a sandy, bouldery till.

d) Aquatic Ecology

Waterbury Lake is a large lake with numerous islands and depths exceeding 45m. The lake shores are steep and rocky. The water is clear and cold all year. Cold water fish are abundant, particularly lake trout and whitefish.

Longyear Bay and Seru Bay are appendages of Waterbury Lake. They are relatively shallow with extensive rocky zones around the shore. The bay basins contain soft black organic sediments.

There are a number of small headwater lakes in the area which have similar aquatic characteristics (Cigar Lake, Cat Lake, Sawatsky Lake, Bizarre Lake).

Aline Lake is a small, shallow, isolated headwater lake. The shore lines are rocky and the basin is saucer shaped with extensive dropout of soft organic sediments. There are many areas of submerged and floating plant growth. Water levels are regulated by an inactive beaver dam at the outlet. Aline Creek is a slowly meandering and braided channel through wet marsh land. The creek remains open for flow all year.

Stream and river systems in the area have irregular and rapidly changing channels. Riffles and gravel substrates are limited to areas of high gradient between larger waterbodies. Habitat is suited to invertebrate production and supports Artic Grayling populations. There are no apparent barriers to fish movement in these systems.

The phytoplankton and algae populations inhabiting the lakes of the area appear to have larger biomass levels than expected from the analysis of the water chemistry.

Poor development and sparse vegetation in the shallow zones of the lakes suggest poor growth conditions due to low temperatures, short growing seasons, and the inorganic nature of the lake bed material.

The density, biomass and diversity of zooplankton populations were high enough to provide an ample food base for the planktivorous fish species in the lakes.

Benthic invertebrate populations which inhabit the bottom sediments of lakes and streams in the area are profundal and diverse and again suggest compatible physical and chemical features of the lake or stream water.

Fish species composition and distribution is relatively uniform throughout the region. Lake trout, lake whitefish are predominant in the large deeper lakes, while northern pike and walleye are most abundant in the shallow water habitats.

Aline Lake suffers oxygen depletion in late winter months and thus the resident fish population of northern pike are small in size and limited in population.

Seru Bay has the same fish species as other portions of Waterbury Lake. All the major habitat requirements for northern pike, lake trout and longnose suckers are found in Seru Bay.

6.4 Socio Economic and Resource Utilization

The project site is situated within the socio-economic region known as the Athabasca Basin. The population of the Basin region is wholly accommodated by the communities of Camsell Portage,

Uranium City, Fond du Lac, Stony Rapids, Black Lake, and Wollaston Lake. There is no "rural" population outside of these six communities. The total permanent population numbers about 3,000.

The economic base of the Athabasca Basin depends upon four sources of income; the private sector, the public sector, land use and resource harvesting, and monies recovered through transfer payments. The private sector economy is dominated by the mining industry. The public sector economy represents the provision of goods and services by Federal, Provincial and Municipal levels of government. There are four principal land use and resource harvesting patterns currently undertaken in the Waterbury Lake area, these are trapping, commercial fishing, sport fishing and mineral exploration.

CLMC implemented a public consultation program in 1985. Discussions and meetings have been held with regional communities along with site visits to provide first hand knowledge of the developing project. To date, there appears to have been positive acceptance and support for the test mine project by local residents.

6.5 Background Radiation and Trace Element Levels

Baseline levels of ambient radon gas were measured and ranged from 0-7.4 Bq/m^3 (Becquerel per cubic metre). Radon gas values reported by UNSCEAR (1986) for air over continental land masses ranged from 1 to 10 Bg/m^3. Gamma radiation baseline exposures ranged from 7 to 8.5 ur/h (micro-rad per hour) which is slightly above the average background for Canada of 4-5 ur/h.

Sampling and analysis for radionuclide and trace element content in terrestrial vegetation, lake sediments, aquatic macrophytes and fish for the local area around the project site showed values which were the same as or lower than regional data and the U.S.A. Environmental Protection Agency reference information.

7.0 POTENTIAL IMPACTS AND MITIGATIVE MEASURES

The effects of the Test Mine Project and its various activities can be summarized by the following table:

TEST MINE PROJECT
ENVIRONMENTAL IMPACTS

Activity	Environmental Output or Product	Impact Component
Overall Project	Employment Spinoffs	Socio-economic
	Road Access	Socio-economic
	Site Development	Heritage Resources Wildlife
	Air Emissions	Soils & Vegetation
Shaft Sinking	Treated Minewater Discharge	Surface Hydrology Surface Water Quality
	Waste Rock Storage	
Lateral Underground Development	Treated Minewater Discharge	Surface Water Quality
	Waste Rock Storage	Surface Topography
	Low Grade Ore Storage	Surface Hydrology
Stope Testing	Ore Storage	Surface Hydrology
	Special Waste Storage	
Construction Camp	Sewage Disposal	Surface Water Quality
Containment Areas	Surface Runoff	Surface Hydrology
Roadways, Gravel Pits, Airstrip Garbage Disposal	Surface Runoff	Surface Hydrology Surface Water Quality

Based on this summary, it would appear that among the environmental impact components, and surface water quality, surface topography and hydrology plus socio-economic factors are potentially the most effected by the Test Mine Project.

7.1 Air Quality

The Industrial Source Complex Long Term Air Dispersion Model was used to predict the ground level concentrations of emissions originating from both point (mine upcast) and area (ore and special waste stockpiles) sources within the site development

Highest predicted radon concentrations are in the order of 0.0037 to 0.0074 Bq/L which are comparable to natural background and do not represent any unusual hazard.

Predicted levels of inorganic dust, organic particulates and sulphur dioxides from diesel fuel combustion were well below the regulatory limits and would not result in any significant effects.

Because the predicted levels of impact are so low, no mitigative measures are planned to control air quality. If dust releases become a problem, water sprays or application of dust suppressants will be required.

7.2 Terrestrial Environment

Site preparation and construction activities will result in some removal of existing natural vegetation. No rare or endangered vegetation species were found in the project development area. Mitigation will involve the limiting of damaged areas, revegetation, and precaution against fire hazards. Due to the short growing season, vegetation recovery periods are slow and until the vegetation and trees fill in the clearings the aesthetic appearance of the developed site will be adversely affected.

The impact of the project on wildlife in the area is expected to be minimal due to the low population and number of species present.

With increased human activity in the area some wildlife will probably be displaced. On the positive side, this is a desirable effect as the close interaction of wildlife in populated areas usually results in accidental death or exploitation of the wildlife population.

One active Bald Eagle's nest near the mouth of the Whiteford River may be displaced and this would be considered a residual impact.

No impact is predicted on the migrating caribou herds as their occasional southern most extension is the north end of Waterbury Lake.

A possible impact of the test mine project, will be its effect on the fisheries resources in Waterbury Lake. The lake has a documented sustained yield of useable fish based on the lakes natural ability to restock. This sustained yield is presently close to the amount removed by existing recreational fishing. Increased recreational or commercial fishing on the lake would, in all likelihood, reduce the catch success rate and size of fish caught. Careful management of the fisheries resources in Waterbury Lake will be required.

7.3 Aquatic Environment

The Test Mine Project will discharge a maximum of $835m^3/hr$ of water during shaft sinking and mine development. Domestic sewage and contaminated surface runoff represents an insignificant portion of this volume. Contaminated shaft and mine development water will be chemically treated to meet regulatory standards before discharge.

The additional $835m^3/hr$ flow into the Aline Lake watershed will represent a 200% increase in flow rate through Aline Creek during average conditions, a 400% increase in flow rate through Aline

Creek during drought conditions and will represent only about 25% of the total flow during flood conditions. Based on average conditions the average flushing rate of Aline Lake will be reduced from 24 days to 16 days (i.e.) the time taken for one complete volume change. A flushing rate in excess of 6 days is not expected to significantly effect the aquatic biology of Aline Lake.

Mitigation measures which will be followed to minimize the surface hydrology impacts are:

a) minimum alteration to natural water drainage
b) keep area of Test Mine Site to a minimum
c) reduce as much as possible, the minewater inflow pumped to the surface
d) diffuse any water discharge to reduce channelling or erosion.

Removal of minewater inflows by pumping may, in time, lower the water level surface around the project site. It is not expected to have any major effect on the Cigar Lake level or any noticable impact on Waterbury Lake. Sealing of the formation around the mine workings by grouting will reduce the amount of inflow.

The effect of the water discharged from the Test Mine Project, (on the aquatic environment) will depend upon the existing quality of the receiving waters and the quality of the effluent. Existing or background quality of the receiving waters is well documented and based on a predicted quality of the effluent and calculating the various dilution effects and natural attenuation as the streams travel through muskegs and wetlands, the impact on surface water quality in Aline Lake is expected to be minor and insignificant in Seru Bay.

Discharged water quality will be monitored carefully at the end of the discharge pipe from the water treatment plant. Should the

effluent exceed regulatory limits, appropriate mitigative action would be carried out by adjustment of the water treatment plant operation.

7.4 Socio-economics

Socio-economic impacts related to the Test Mine Project will be limited due to the size of the project and the employment opportunities available. Impacts are expected to focus on employment and northern business opportunities.

The very small size of the on-site workforce, the short duration of the individual contracts and the limited labour skills in the region will reduce the available employment opportunities.

During the surface construction phase, it is expected that CLMC and its contractors will be able to provide some employment opportunities to qualified residents of the communities of Stony Rapids/Black Lake and Wollaston Lake/Lac La Hache. The principal local employment impacts which may be experienced will be limited to general labourers, heavy equipment operators, catering staff positions and possibly trades helper employment opportunities. In total, the surface construction activities involved in the Test Mine will create 176 person weeks of employment opportunities in these skill categories between June and November, 1987.

Upon completion of the surface facilities (temporary access road, internal roads, water management and treatment, temporary camp, etc.) in 1987, site activities during 1988-89 will be predominantly underground. The majority of the work will be related to sinking the shaft (10 months); lateral developments (5 months); and the actual test mining (7 months).

On site surface employment by contractors during the 1988-89 period will be limited to a few labourers, heavy equipment operators and the catering personnel. In summary, it is expected

that these limited opportunities will total not more than 198 person weeks of employment over a 22 month period.

Regional impacts would be felt along the ground transportation route Highway #2, 102, and 905 to Points North. La Ronge, being on the transportation route between Saskatoon and CLMC site would benefit from the pick-up of contractors and supplies.

8.0 ENVIRONMENTAL MONITORING DURING THE PROJECT

A comprehensive monitoring program will be designed for the test mine project. Parameters which will be monitored are:

- air quality (radon gas and particle content)
- surface water hydrology
- surface water quality (discharge & receiving)
- lake sediment (chemistry)
- radiological (alpha and gamma exposure)
- aquatic biological response
- groundwater (quality and level)

9.0 CONTINGENCY PLANNING

Contingency planning is required for the operating phase of the Test Mine Project in order to mitigate any unplanned occurrence which might jeopardize the environmental integrity of the project. Procedures will be required for such unplanned events as:

a) failure of a containment dyke or effluent pipeline;
b) shutdown of the water treatment system;
c) spills of contaminated material;

Containment dyke failures result in large amounts of damage due to the potential created by the storage of large volumes of liquid. Breeching, overtopping, or piping failures are normally guarded against by close and routine observation of dyke performance, close control of liquid inventories, and proper engineering design. Proper location of the holding ponds and dyked areas has allowed for the possibility of failure and the ultimate destination of uncontrolled liquid flow is the wetland containment area which is a natural topographic low point with inventory and flow control at the outlet to Aline Lake.

Pipeline failure can be handled easily by isolation of the failed pipe. Knowledge of a pipeline failure is normally a part of process control and is managed by "alarming" flow meters or loss of pressure guages.

Spills of contaminated solid material will be accounted for by report and upon reporting will be recovered and cleaned up using equipment such as payloaders and dump trucks. Radiometric survey will define the extent of cleanup required.

Unexpected shutdowns of operating equipment will be handled in the normal manner by predeveloped operating procedures.

10.0 DECOMMISSIONING OF THE TEST MINE FACILITIES

Once the test mine is completed there will be a temporary halt in the proceedings while the data and information acquired during the test mine sequence is evaluated to determine the feasibility of the project.

If the feasibility study proves to be positive and the project gets owner approval to proceed with the development of a full scale project, then a project proposal for full-scale development would be prepared and submitted to the Saskatchewan Department of

Environment. Should the feasibility study arrive at a negative decision then appropriate demobilization and decommissioning would take place.

Temporary facilities such as the construction camp, exploration camp and shaft sinking facilities would be dismantled according to regulatory Mineral Exploration Guidelines. Any other permanent surface structures would be appropriately mothballed until a decision was made as to their disposal. Provision would be made to dispose of the ore and special waste rock brought to surface during the test mining by transportation to a local milling operation for processing or by return to underground workings. Surface features such as pits, lagoons, access roads, stockpiles would be returned as much as possible to natural topography in accordance with the section on "Decommissioning and Abandonment" in the Guidelines for Environmental Protection During Road Development.

The quality of surface water systems will be monitored for some period of time after shutdown to ascertain that impact on the local environment was in fact temporary.

All salvageable supplies and equipment such as fuel tanks and drums, building lumber and piping, would be removed from site.

The property would be posted with signs to advise visitors of possible risks.